sulting and advisory body. Besides the resolutions mentioned already it was determined that the international ascents of balloons and kites during the next year should take place, as has been the case this year, on the first Thursday of every month and that at least one of the *ballons-sondes* liberated at any station should be sent up one hour before sunrise in order that its records may not be affected by solar radiation, and also that the balloon may be seen when it falls to earth in the early morning. The Richard thermograph, with Teisserenc de Bort's insulating device, should be used and the Hergesell instrument having a tube of German silver, instead of the Bourdon tube, filled with alcohol, was also recommended on account of its sensitiveness and durability. Ascensions at other hours and with different apparatus are discretionary. The president, Prof. Dr. Hergesell, in summing up the results of the Congress, which he regarded as eminently satisfactory, laid special importance on the meteorological kite flights that were proposed over seas, lakes, and mountains, and hoped that the British Government, by similar work in India, would help in the investigation of the great Asiatic monsoon region. A grant of money was requested from the German Government to enable the Prussian Meteorological Institute to cooperate with the writer in his proposed investigation of the atmosphere over the Atlantic Ocean. It was announced that in order to facilitate international researches in scientific aeronautics, the formation of an organization, sustained by the various European nations, would be attempted. The Congress was then closed with the usual votes of thanks.

ON THE CALIFORNIA CHARTS OF RAINFALL.

By ALEXANDER G. MCADIE, Professor and Section Director, United States Weather Bureau, dated August 20, 1902.

Referring to the symposium on "Rainfall and charts of rainfall," in the MONTHLY WEATHER REVIEW for April, 1902, I respectfully refer to the map published in the Annual Summary for 1900, of the California Section of the Climate and Crop Service, where it will be noted that in charting rainfall due allowance has been made for the topography of the State. The intimation by Mr. Henry Gannett, on page 224, that in preparing our rainfall maps we only consider the rain gage measurements, is hardly fair to the California service, for the reason that the isohyets in this State have, during the past three or four years, been drawn with special reference to the orography. We do not show the area of the precipitation over the Sierra Nevada to be the same as that measured at Fresno, Stockton, or Owens Lake. Mr. Gannett must have been unaware of the methods followed at this office in charting rainfall, and I will be glad to have his attention called to this matter, as I am sure that he will appreciate our method. A relief map of the State is always placed underneath the tissue paper chart of the State on which the rainfall data are assembled.

On page 225 Mr. F. H. Newell is likewise in error in his statement that the rainfall maps of the Weather Bureau, "while undoubtedly good for the more thickly settled parts of the United States are very misleading for the western two-fifths of the country because the great mountain ranges are ignored." On page 226 Mr. Newell suggests that some one familiar with the topography should sketch the rainfall map. It is believed that this is not nearly so good as the method which we have followed for years.

After carefully reading the symposium published in the MONTHLY WEATHER REVIEW on "Rainfall and charts of rainfall," I fail to see wherein the chart of precipitation published by the California Section can be improved under the present limitations of our knowledge. It would be unwise to make use of an indefinite factor based upon the element of forestation. Mr. Gannett's contention[1] that certain timber belts upon the Sierra Nevada might be utilized in drawing the isohyets fails to find support in the views of Professor Goodale, Professor Sargent, Professor Merriam, Professor Fernow, and our forester, Mr. Pinchot. To introduce such a factor would certainly make the map of rainfall in California, in the words of Dr. Hann, "a subjective work of the imagination." As an illustration of the uncertainties attending forest growth and its relation to rainfall I would call attention to a redwood grove on the windward side of Mount Tamalpais. The rainfall from May until October is nil, but below the crest of the mountain dense fog prevails in great blankets. The crowns of the redwood trees, averaging possibly 200 feet from the ground, are bathed in moisture for from five to eight hours nearly every day during the summer months. The character of the forest here is, therefore, largely determined by temperature, humidity, and shelter from high winds rather than rainfall.

With reference to Mr. Newell's contention that our rainfall records are not kept with that degree of accuracy which we profess (see page 226), I would say that in California we have many earnest rainfall observers who for long years have maintained records which I believe will compare favorably with any set of instrumental records maintained by any institution in the world. Our records show cases where observers have carefully measured the dimensions of their collectors and receivers, and finding a difference in the third or fourth decimal place from the figures given by our Instrument Division have reported the same to this office.

Again on page 225 Mr. Newell contends that our rainfall maps are misleading in that few, if any stations, can be used in accurately measuring the amount of water flowing from mountain streams. Possibly the methods employed in measuring the total volume of discharge of these streams for a year are at fault.

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The hydrographer assumes that mountains necessarily cause a rainfall divide. In a State like California with mountain systems running at various angles to the prevailing air movement, and where wind circulations are frequently reversed with seasonal changes, the determination of average rainfall is a difficult problem. The greatest rainfall may or may not occur beyond the crest of a given range. Should it occur on the side of the divide farthest from the origin of the rain bearing winds any argument based upon elevation and the run-off in a given watershed would be untenable.

I have in recent conversation with Mr. Newell called his attention to the care with which the isohyets have been drawn in California, and I now understand that his criticism did not apply to California. We are indeed only too thankful to have our work criticized if the criticism shall lead to improvement.

In place of the suggestion of Messrs. Gannett and Newell that our rainfall charts be modified so as to "obtain the relations between the flow of streams, the altitude, the vegetation, and the rainfall" (see page 206), would it not be better to begin a systematic study of the forces at work in the formation of the raindrop? Then, possibly, we shall be able to discuss intelligently the true values to be allowed for the influence of forests, mountains, timber belts, etc. From the office of the Weather Bureau at San Francisco one can see day after day vast quantities of condensed water vapor passing inland, undergoing many changes and yet without resulting precipitation. Even if this fog and vapor could be measured it would be improper to allow for it in drawing the rain chart, and yet it plays an important part in modifying climate.

In conclusion, I repeat that the isohyets in California have been drawn with care, and as much allowance made for topography as the present state of our knowledge permits. Every effort will be made to maintain rainfall data of a high degree of accuracy. The criticism of our maps was made without a

[1] Page 206 Monthly Weather Review for April, 1902.

good knowledge of the methods employed in charting. The suggested modifications have not sufficient authority back of them to warrant consideration as factors in charting rainfall.

THE DATE LINE IN THE PACIFIC OCEAN.

By JAMES PAGE, United States Hydrographic Office, dated September 5, 1902.

In charting meteorological data from the various land stations in the Pacific Ocean confusion is apt to arise owing to the lack of uniformity on the part of the several island groups as to the calendar date employed. Certain of the islands to the westward or on the Asiatic side of the meridian of 180° employ the American date, while others to the eastward or on the American side of the meridian employ the Asiatic date, which is of course one day later than the American; 8 a. m. of Monday, June 9, in west longitude, becoming 8 a. m. of Tuesday, June 10, as soon as east longitude is attained, and similarly for other hours and days.

It is obviously desirable that local practise should, in this respect, conform as nearly as circumstances will permit with the astronomical rule which makes the date line follow the meridian of 180° throughout. At the present time the approximation is very close, although this has not always been the case. A notable exception was that of the Philippine Islands, which, prior to 1845, observed the American date; their discoverer, Magellan, having approached them from America, and the islands themselves having for many years maintained an active trade with Acapulco on the Mexican coast. The island of Celebes, on the other hand, in the same longitude as Luzon (120° E.), observed the Asiatic date. An event described as having taken place at 8 a. m. of Monday, June 5, in Philippine annals, would thus be described as having occurred at the same hour of Tuesday, June 6, in the annals of Celebes. To remove this incongruity the Manila authorities accordingly decreed that December 31, 1844, should be dropped from the calendar, December 30 being immediately followed by January 1, 1845. Prior to its purchase by the United States in 1867 the Asiatic (Russian) date was employed throughout the whole Territory of Alaska, while the Samoan archipelago clung to the Australian date until July 4, 1892.

At the present time the islands of the Pacific keep their dates, as shown in the following list, compiled from the Pilot Chart of the North Atlantic Ocean for September, 1899, published by the United States Hydrographic Office:

American date: Alaska, St. Lawrence Island, all the Aleutian Islands (Attu, the most westerly, is situated in longitude 173° E.), Morell Island, Phœnix Islands, Samoan Islands.

Asiatic date (one day later than the American date): Siberia, Kamchatka, Copper Island, Komandorski Island, Marshall Islands, Gilbert Islands, Ellice Islands, Fiji Islands, New Zealand, Chatham Island.

When it is Saturday the first day of the month throughout the islands on the eastern or American side of the date line it is Sunday the second day of the month throughout those on the western or Asiatic side, and this is true of any hour of the day or night.

In order to make their dates agree with those of their ports of call, it is the universal custom of shipmasters when westward bound to omit from the log the date immediately succeeding that on which the meridian of 180° is crossed, and when eastward bound to repeat this date, notice of this fact being given and events on board dated accordingly. In the case of simultaneous observations aboard such vessels, the matter is further complicated by the fact that, in addition to this change of date, the local time is constantly changing. The United States Hydrographic Office has for several years past been engaged in the construction of daily synoptic weather charts of the North Pacific Ocean, showing the barometric pressure, the force and direction of the wind, the proportion of cloudy sky, etc., prevailing each day at the hour of mean noon on the meridian of Greenwich, the basis of these charts being the daily simultaneous observations taken at this hour aboard the ships scattered over the entire ocean. As a vessel approaches the meridian of 180° from the eastward, the hour of observation, which is the local or ship's time corresponding to Greenwich mean noon, becomes successively earlier and earlier, and, upon crossing the meridian, changes from a. m. of the given date to p. m. of the next immediate following date. To illustrate by an example, assume that a vessel westward bound and making four degrees of longitude daily, finds herself at the instant of Greenwich mean noon of June 15 in longitude 179° west. The local date and time of the meteorological observation will be June 15, 0 h. 4 m., a. m. The meridian of 180° will be crossed about 6 a. m. of June 15, which, by virtue of crossing this meridian, immediately becomes 6 a. m. of June 16, and the local date and time of the next Greenwich mean noon meteorological observation (the vessel having reached 177° east), will be June 16, 11 h. 48 m. p. m. Many observers, however, mindful of the necessity of dropping a day from the ship's local record, consider it essential to drop a day from the Greenwich mean noon record, and (incorrectly) date the second observation June 17, 11 h. 48 m. p. m., and likewise all subsequent observations throughout the voyage one day in advance of the actual date. The same error, but with opposite sign, is of equally frequent occurrence in the case of eastward bound ships, all Greenwich mean noon observations subsequent to crossing the one hundred and eightieth meridian bearing date one day behind the truth. In tabulating or plotting simultaneous meteorological observations at sea it is therefore highly essential to carefully scrutinize the record in this respect.

French vessels reckon their longitude from the meridian of Paris (2° 20′ east of Greenwich) and change their date upon crossing the meridian 180° distant from this, i. e., in longitude 177° 40′ west of Greenwich.

Spanish vessels reckon their longitude from San Fernando (6° 14′ west of Greenwich) and would naturally change the date in longitude 173° 46′ east of Greenwich. The number of vessels of Spanish nationality engaged in this trade is, however, small and it is impossible to speak with precision as to their custom in this respect.

CLIMATOLOGY OF COSTA RICA.

Communicated by H. PITTIER, Director, Physical Geographic Institute.

[For tables see the last page of this REVIEW preceding the charts.]

Notes on the weather.—On the Pacific slope the precipitation was deficient and irregularly distributed. In San Jose the pressure was about normal, the temperature slightly below the average, and the rainfall 163 mm. against a normal of 241 mm. The sky was generally cloudy, with only 103 hours of sunshine, the normal being 119 hours. The prospects for the next coffee crop are poor. On the Atlantic slope the rainfall was generally in excess of the normal, occasioning everywhere inundations and landslides.

Notes on earthquakes.—July 5, $5^h\ 17^m$ a. m., slight shock, NW–SE, intensity III, duration 9 seconds. July 8, $3^h\ 03^m$ p. m., very light shock, NW–SE, intensity I, duration 3 seconds. July 8, $11^h\ 51^m$ p. m., light shock, NNW–SSE, intensity II, duration 9 seconds. July 18, $11^h\ 24^m$ a. m., tremors. July 19, $9^h\ 05^m$ p. m., pretty strong shock, E–W, intensity III, duration 9 seconds. July 22, 4^h p. m., very light, NW–SE, intensity I, durations 4 seconds. July 25, $11^h\ 25^m$ a. m., slight, N–S, intensity II, duration 4 seconds. July 29, $8^h\ 05^m$ p. m., very slight, E–W, intensity I, duration 4 seconds. Contrary to newspaper reports the Costa Rican volcanoes have become quiet, and there are absolutely no indications of unusual activity.